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[54] **HUMAN-FACTORED INTERFACE
CORPORATING ADAPTIVE PATTERN
RECOGNITION BASED CONTROLLER
APPARATUS**

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364/191; 382/155**

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364/148-150, 164, 165, 192; 395/156-160,
20; 382/155, 156-160**

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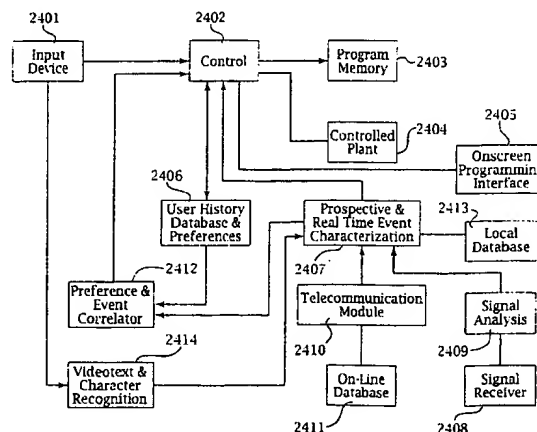
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[57] **ABSTRACT**

The need for a more-readily usable interface for programmable devices is widely recognized. The present invention relates to programmable sequencing devices, or, more particularly, the remote controls for consumer electronic devices. The present invention provides an enhanced interface for facilitating human input of a desired control sequence in a programmable device by employing specialized visual feedback. The present invention also relates to a new interface and method of interfacing with a programmable device, which is usable as an interface for a programmable video cassette recorder.

37 Claims, 27 Drawing Sheets



What is claimed is:

1. A programmable control, having a status, responsive to an user input and a signal received from a signal source, comprising:
 - a controller, for receiving the user input and the signal and producing a control output;
 - a memory for storing data relating to an activity of the user;
 - a memory for storing data relating to a plurality of user profiles;
 - a processor for characterizing said user input to produce a characterized user input;
 - means for comparing said characterized user input with at least a portion of said stored data to produce a comparison index;
 - a data processing system for adaptively predicting a most probable intended action of the user based on said stored data relating to said activity of the user and derived weighting of at least a subset of possible choices, said derivation being based on a history of use, a context of a respective choice and said status of the control; and
 - a user feedback data presenting system comprising an output device for presentation of a variable sequence of programming options to the user, including said most probable intended action of the user, in a plurality of output messages, said output messages differing in available programming options,
 - said variable sequence of programming options being determined on the basis of said comparison index.
2. The programmable control according to claim 1, being for performing an action based on user input and an information content of a signal received from a signal source, wherein said output device includes a display device, further comprising:
 - a user controlled direct manipulation-type input device, associated with said display device, having a device output, said device output being the user input;
 - a plant capable of performing the action, being responsive to an actuator signal; and
 - said controller, being for receiving data from said device output of said input device and the signal, and displaying user feedback data on said display device,
 - said logical sequence of said user feedback data including at least one sequence of options sufficient to define an operable control program, and a presentation of additional programming options if said control program is not operable.
3. The programmable control according to claim 1 wherein said signal comprises a time-code signal, and said direct manipulation-type input device and associated data display device present programming options to the user comprising time-based programming options having associated relative positions on said display image, said time based programming options comprising an absolute time programming option and a relative time programming option, said controller producing said actuator signal based on said predetermined program, said control program, and said time-code signal.
4. The system according to claim 1, further comprising:
 - a user input processing system for adaptively determining a viewer preference based on the user input received by said controller;
 - a program material processing system for characterizing the program material based on its content;

- a correlator for correlating said characterized content of the program material with said determined viewer preference to produce a correlation index; and
 - a processor, selectively processing the program material based on said correlation index,
 - said data processing system receiving an input from said processor.
5. The system according to claim 4, wherein said program material is encrypted, further comprising:
 - a decryption system for decrypting the program material if it is selected to produce unencrypted program material and optionally an associated decryption event;
 - a memory for storing data relating to the occurrence of said decryption event; and
 - a central database for storing data relating to the occurrence of said decryption event in association with data relating to the viewer.
 6. The system according to claim 4, wherein:
 - said user input processing system monitors a pattern of user activity and predicts a viewer preference;
 - said program material processing system comprises:
 - a processor for preprocessing the program material to produce a reduced data flow information signal substantially retaining information relating to said abstract information content of the program material and selectively eliminating data not relating to said abstract information content of the program material and for characterizing said information signal based on said abstract information content; and
 - a comparing system for determining if said correlation index is indicative of a probable high correlation between said characterization of said information signal and said viewer preference and causing said stored program material to be processed by said processing means based on said determination.
 7. The system according to claim 4, wherein said processor comprises an image program material storage and retrieval system.
 8. The system according to claim 4, further comprising a memory for storing a characterization of the program material; an input for receiving a feedback signal from the viewer indicating a degree of agreement with said correlation index determination, wherein said feedback signal and said stored characterization are used by said viewer preference predicting means to predict a new viewer preference.
 9. The programmable according to claim 1, wherein:
 - said data relating to a plurality of stored profiles comprises a plurality of stored profiles; and
 - said means for comparing compares said characterized user input with at least one of said plurality of stored profiles to produce said comparison index.
 10. The programmable controller according to claim 1, further comprising:
 - a plurality of stored profiles;
 - a processor for characterizing the signal to produce a characterized signal;
 - means for comparing said characterized signal to said plurality of stored profiles to produce a comparison index,
 - wherein said processor for characterizing performs an algorithm on said signal comprising a transform selected from the group consisting of an Affine transformation, a Fourier transformation, a discrete cosine transformation and a wavelet transformation and said status of the control includes said comparison index.

11. The programmable controller according to claim 1, said controller being for controlling a recording device for recording an analog signal sequentially on a recording medium having a plurality of uniquely identifiable storage locations, further comprising a sequential recording device for recording the analog signal, and a memory for storing, in a directory location on the recording medium which is separate from the storage location of the analog signal, information relating to said signal, processed to selectively retain characterizing information, and an identifier of a storage location on the recording medium in which said analog signal is recorded.

12. The programmable control according to claim 1, wherein said user feedback data presenting device comprises a display having a plurality of display images, said display images differing in available programming options.

13. An adaptive programmable apparatus having a plurality of states, being programmable by a programmer and operating in an environment in which a plurality of possible events occur, each of the events being associated with different data, comprising:

- an data input for receiving data;
 - an programmer input, producing an input signal from the programmer;
 - a memory for storing data relating to said data input or said input signal;
 - a feedback device for adaptively providing information relating to said input signal and a current status of the apparatus to the programmer, based on said data input or said programmer input, said stored data, and derived weighting of at least a subset of possible choices, said derived weighting being based on a history of use, a context of a respective choice and said current status of the apparatus;
 - a memory for storing programming data associated with said input signal; and
 - a processor, having a control output, for controlling the response of said apparatus relating to the detection of said input signal or said data in accordance with said stored programming data,
- said processor:
- processing said at least one of said input signal or said data to reduce an amount of information while substantially retaining an abstract portion of said information,
 - storing a quantity of said abstracted information,
 - processing said abstract portion of said information in conjunction with said stored quantity of abstracted information,
 - and providing said control output based on said processed abstract portion of said information and said stored programming data.

14. The apparatus according to claim 13, further comprising:

- an input for receiving a programming preference from the programmer indicating a plurality of possible desired events;
- said processor further including a correlator for correlating said programming preference with said data based on an adaptive algorithm and for determining a likelihood of occurrence of at least one of said desired events, producing said control output.

15. The apparatus according to claim 13 further comprising:

- an input for receiving feedback from the programmer indicating a concurrence with said control output of

said processor, and modifying said response control based on said received feedback to increase a likelihood of concurrence.

16. The programmable apparatus according to claim 13, wherein said processor verifies said programming data to ensure that said programming data comprise a complete and consistent set of instructions; and

includes a feedback system for interactively modifying said programming data.

17. The programmable apparatus according to claim 13, further comprising a chronological database and an accessing system for accessing said chronological database on the basis of said programming data stored in said memory.

18. The programmable apparatus according to claim 13, wherein said processor receives information from said input signal.

19. The programmable apparatus according to claim 13, wherein said processor receives information from said data.

20. The programmable apparatus according to claim 13, further comprising an input signal memory for storing at least a portion of said input signal or said data, a profile generator for selectively generating a profile of said input signal or said data, and an input signal profile memory for storing said profile of said input signal or said data separately from said input signal or said data in said input signal memory.

21. The programmable apparatus according to claim 20, further comprising a processor for comparing said input signal or said data with said stored profile of said input signal or said data to determine the occurrence of an event.

22. The programmable information storage apparatus according to claim 21, wherein said data comprises image data and said processor for comparing performs image analysis.

23. The programmable control according to claim 1, said signal source being an image signal source, further comprising:

- means for storing characterization data representing a plurality of image types, having an output; and
 - an image processor, receiving an input from said image signal source and said output from said characterization data storage means, and producing a signal corresponding to a relation between at least one of said plurality of image types and said image signal source,
- said programming options controlling an operation of said image processor.

24. The programmable control according to claim 1, said signal source comprising means for simultaneously transmitting data representing a plurality of programs, said control further comprising:

- means for selecting at least one of said plurality of programs, being responsive to an input;
- a program database containing information relating to said plurality of programs and including data relating to said subset of possible choices;
- said programming options defining an operation to be conducted with respect to a program.

25. The programmable control according to claim 1, wherein said user feedback data presenting system includes a graphical user interface for defining commands, comprising:

- (a) an image display device having at least two dimensions of display, being for providing visual image feedback; and
- (b) a multidimensional input device having at least two dimensions of operability, adapted to correspond to said two dimensions of said display device, and having an output,

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so that the user may cause said input device to produce a corresponding change in an image of said display device by translating an indicator segment of said display in said at least two dimensions of display, based on said visual feedback received from said display device, said indicator segment being moved to a translated location of said display device corresponding to a user command.

26. The programmable control according to claim 1, said user feedback data presenting system comprising a visual display device, having an alterable type, further comprising:
 means for detecting one or more temporal-spatial user characteristics of the input signal, independent of said programming options, selected from the group consisting of a velocity component, an efficiency of input, an accuracy of input, an interruption of input and a high frequency component of input;
 means for storing data related to said user characteristics in a memory; and
 means for altering said image type based on the user characteristics.

27. The programmable control according to claim 26, wherein said means for altering said image type alters said image type based on an output of detection means and said stored data so that said display device an image type which corresponds to said detected user characteristics.

28. The programmable control according to claim 26, being for controlling the causation of an action on the occurrence of an event, further comprising:

control means for receiving and storing a said programming option, said programming option directing an aspect of performance of an action on the occurrence of an event; and

means for monitoring an environment of said apparatus to determine the occurrence of the event, and causing the performance of the action on the occurrence of the event.

29. The apparatus according to claim 28, wherein said means for altering said image type alters said image type based on an output of detection means and said stored data so that said display means displays an image type which corresponds to said detected user characteristics.

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30. The apparatus according to claim 1, wherein at least one programming option defines a pattern characteristic, further comprising a pattern recognition engine for determining a correspondence of said defined pattern characteristic and the signal received from the signal source, and wherein at least one programming option defines an operation to be performed on the signal received from the signal source, contingent on said correspondence.

31. The programmable control according to claim 1, further comprising an input for receiving data relating to the signal received from the signal source, said data relating to the signal received from the signal source defining the location of events within the signal received from the signal source, said data relating to the signal received from the signal source being comprising said subset of possible choices.

32. The programmable control according to claim 1, wherein the signal received from the signal source includes data relating to real or synthetic processes, further comprising means for modeling said real or synthetic processes based on the signal received from the signal source to define at least one model, at least one of said possible choices corresponding to a function relating to said model.

33. The programmable control according to claim 1, wherein said means for comparing said characterized user input with at least a portion of said stored data to produce a comparison index comprises a neural network.

34. The programmable control according to claim 1, wherein said data processing system comprises a neural network.

35. The programmable control according to claim 1, wherein said context of a respective choice is evaluated by a neural network.

36. The programmable control according to claim 1, wherein said context of a respective choice is evaluated based on an analysis of the signal received from the signal source.

37. The programmable control according to claim 1, wherein said context of a respective choice is evaluated based on a pattern recognition analysis of the signal received from the signal source.

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